

Barnacles (Cirripedia, Thoracica) of seas off Réunion Island and the East Indies

by Brian A. FOSTER† and John S. BUCKERIDGE

Résumé. — Les Cirripèdes récoltés, principalement à l'aide de dragues et de bennes, au voisinage de La Réunion, dans le sud-ouest de l'océan Indien, lors de la campagne MD32 du « Marion Dufresne », sont étudiés ici d'un point de vue systématique. Quelques autres Cirripèdes de mer profonde, en provenance des Philippines et d'Indonésie, sont également examinés. Tout le matériel étudié a été trié au CENTOB à Brest. Au total trente et une espèces sont recensées, cinq d'entre elles sont nouvelles pour la science. Une attention particulière est portée aux espèces de Scalpellidae qui sont au nombre de treize dont une nouvelle et aux espèces de Verrucidae qui sont au nombre de huit dont deux nouvelles. De plus, une espèce nouvelle d'*Oxynaspis* et une autre d'*Acasta* sont décrites. Dans cet article, on n'a considéré que l'identification des espèces et leur biogéographie. Les problèmes posés par la phylogénie, ainsi que les conditions hydrologiques et les particularités écologiques propres à chaque campagne n'ont pas été abordés.

Mots-clés. — La Réunion, Scalpellomorpha, Verrucomorpha, Balanomorpha, espèces nouvelles, biogéographie.

Abstract. — The barnacles collected in dredges and grabs from stations off La Réunion Island in the southwestern Indian Ocean (MD32 1982 cruise), which were sorted at CENTOB in Brest, are systematically considered. Additional deep sea barnacles from the East Indies are also considered. Of the 31 species discussed, five are new to science. Particular attention is given to the Scalpellidae with 13 species (one new), and Verrucidae with eight species (two new). As well, a new species of *Oxynaspis* and another of *Acasta* are described. This paper concentrates on the species and their biogeography, leaving aside questions of phylogeny and the ecological and hydrological circumstances of each cruise.

Keywords. — La Réunion Island, Scalpellomorpha, Verrucomorpha, Balanomorpha, new taxa, biogeography.

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INTRODUCTION

This paper describes the collection of cirripedes the late Brian FOSTER received from the Centre national de Tri d'Océanographie biologique (CENTOB), Brest. The original manuscript, submitted just prior to Professor FOSTER's tragic death in July 1992, has been modified, edited and split into two manuscripts, with further figures added where necessary to ensure that all described species are illustrated. This paper deals specifically with Réunion Island material, whilst a subsequent manuscript will deal with material collected from the North Atlantic.

The collection MD 32 was made during August-September 1982: on the slopes of Réunion Island in the Indian Ocean, aboard M. S. "Marion-Dufresne" for the Territoire des Terres

Australes et Antarctiques françaises (TAAF, Paris) under the direction of Dr Alain GUILLE (barnacles from 39 of 181 stations). In addition, a few samples from the East Indies were forwarded for determination.

The main collection results primarily from multiple deep sea dredging in geographically confined areas, and contains species which have previously been known only from few specimens and inadequate descriptions. The aspects of bathymetry, hydrology and ecology underlying the MD 32 cruise have been left for later discussion in context of total faunal composition or oceanographic data. This paper contains only systematic and broad biogeographic considerations.

There are now over 1,000 named species of thoracican cirripedes (*cf.* 151 species in DARWIN's 1851 and 1854 Monographs). Keeping abreast of the primary literature is aided by the review works and catalogues of species that are published e.g. the invaluable review and catalogue of the Balanomorpha by NEWMAN & ROSS (1976), with over 500, mostly extant species listed. For the Lepadomorpha, ZEVINA (1981, 1982) has published species descriptions (in Russian) and nearly full references to 437 extant forms, and has embodied therein the supraspecific classifications she proposed earlier (ZEVINA 1978*a*, 1978*b*, 1980). The Verrucomorpha have not yet been reviewed to the same level, although a literature survey conducted for present purposes has yielded 81 named verrucid species. BUCKERIDGE (1994) provides the most recent review of the Verrucidae, including the description of an extensive fauna from the western Pacific.

MATERIALS AND METHODS

The cruise and station data relevant to the various samples are given in appendix (see page 381). In the following systematic treatment, the stations are referred to by the nomenclature on the labels included in the bottles, namely collecting gear and station number.

The gear used was as follows: CP, beam trawl; DC, Charcot-Picard dredge; DR, rock dredge; DS, Sanders dredge; DW, Waren dredge; FA, Faubert bottom net trawl; PI, submersible dive or SCUBA diver.

Specimens were sorted and preserved in alcohol at CENTOB. New species are given a full description. Others are illustrated from specimens, and their anatomy commented on where existing descriptions need amplification or to note points useful in identification. Appendages were mounted on glass slides in polyvinyl lactophenol. Segments of cirri and caudal appendages were counted per rami, and where a single average figure is given it has been rounded up to an integer value for the complete rami. All material is lodged in the Museum national d'Histoire naturelle (MNHN), Paris, France.

LIST OF SPECIES

Family HETERALEPADIDAE Nilsson-Cantell, 1921

Heteralepas japonica (Aurivillius), 1892

Family POECILASMATIDAE Annandale, 1910

Octolasmis orthogonia (Darwin), 1851

Octolasmis nierstraszi (Hoek), 1907

Megalasma (*Glyptelasma*) *annandalei* (Pilsbry), 1907

Family OXYNASPIDIDAE Pilsbry, 1907

- Oxynaspis alatae* Totton, 1940
- Oxynaspis indica* Annandale, 1910
- Oxynaspis gracilis* Totton, 1940
- Oxynaspis acapitula* nov. sp.

Family SCALPELLIDAE Pilsbry, 1907

- Calantica pusilla* Utinomi, 1970
- Calantica pollicipedoides* (Hoek), 1907
- Trianguloscapellum regium* (W.Thomson), 1873
- Arcoscapellum triangulare* (Hoek), 1883
- Arcoscapellum truncatum* (Hoek), 1883
- Amigdoscapellum praeceps* (Hoek,) 1907
- Amigdoscapellum mamillatum* (Aurivillius), 1898
- Verum? minutum* (Hoek), 1883
- Verum proclive* (Hoek), 1907
- Welmerium poculum* (Hoek), 1907
- Annandoleum laccadivicum* (Annandale), 1906
- Planoscapellum distinctum* (Hoek), 1883
- Verum constrictum* nov. sp.

Family VERRUCIDAE Darwin, 1854

- Verruca trisulcata* Gruvel, 1900
- Verruca sinuosa* nov. sp.
- Verruca cooki* Pilsbry, 1927
- Verruca quadrangularis* Hoek, 1883
- Metaverruca recta* (Aurivillius), 1898
- Metaverruca reunioni* nov. sp.
- Rostratoverruca conchula* (Hoek), 1913
- Brochiverruca dens* (Broch), 1931

Family ARCHAEOBALANIDAE Newman & Ross, 1976

- Acasta fenestrata* Darwin, 1854
- Acasta demura* nov. sp.

SYSTEMATIC PART

Family HETERALEPADIDAE Nilsson-Cantell, 1921

Heteralepas japonica (Aurivillius, 1892)

(Fig. 1 A)

MATERIAL. — MD32/La Réunion: FA40, 150 m (1 specimen); CP57, 227 m (39); CP60, 490 m (14); CP172, 120 m (1).

RECORDS. — AURIVILLIUS 1892: 125, Japan, 82 m; PILSBRY 1911: 71, Japan, 188 m; NILSSON-CANTELL 1921: 246, Japan, 270 m; NILSSON-CANTELL 1927: 755, Java, 327 m, Zanzibar, 494 m, as forma *indica*, Java, 238-915 m, Nicobar Islands, 1903-2090 m, Timor, 183 m, China, 458 m, New Zealand, 128 m; BROCH 1931: 38, Japan-Formosa, 48-500 m; HIRO 1933: 48, Japan, 61 m; NILSSON-CANTELL 1934a: 55,

Sunda Islands, 238-915 m; NILSSON-CANTELL 1934b: 39, Celebes, 750 m; FOSTER 1978: 15, New Zealand, 64-478 m (*i. e.* Indo-West Pacific, 48-2090 m). Synonymy: NILSSON-CANTELL 1927: 755; ZEVINA 1982: 115.

REMARKS

These specimens conform entirely to species from New Zealand waters and to the description given by FOSTER (1978). They are characterised by their squat, slightly hunched posture, with the fluted orifice nearly continuous with the ventral border which itself is notably convex below the orifice. The dorsal crest has 0.3 protuberances. All heteralepadids lack capitular calcification. The present specimens confirm the species' presence in western parts of the Indian Ocean.

Family POECILASMATIDAE Annandale, 1910

Octolasmis orthogonia (Darwin, 1851)

(Fig. 1 B, C)

MATERIAL. — MD 32/La Réunion: CP 172, 120 m (3) on antipatharian.

RECORDS. — HOEK 1907a: 25, Timor and Java, 40-112 m, and as *versuluyisi*, Moluccas, 32 m; PILSBRY 1911: 70, Japan, 188 m; BROCH 1922: 279, Cebu, beach drift; WELTNER 1922: 81, East African coast, 818 m; NILSSON-CANTELL 1925: 21, Formosa, 104 m; NILSSON-CANTELL 1928: 18, Timor, 18 m; BROCH 1931: 38, Kei Islands, 2-260 m, and Formosa 48-120 m; HIRO 1933: 55, Japan, 121-499 m; HIRO 1937a: 415, Japan; STUBBINGS 1963: 327, South Vietnam, 12 m (*i. e.* East African coast through Malaysia to Japan, 18-818 m). On hydroids and such-like bottom animals.

REMARKS

Following HIRO (1937a) these specimens are assigned to *O. orthogonia* by virtue of the trilobed basal margin of the tergum (t in fig. 1B), and the carinal projection of the tergum in larger specimens. However, as HIRO noted, the shell plates are variable in shape, and one aspect of this variation is shown between larger and smaller specimens shown in fig. 1B & C.

Octolasmis nierstraszi (Hoek, 1907)

(Fig. 1 D-F)

MATERIAL. — MD 32/La Réunion: CP127, 92 m (3, on antipatharian and globular polyzoan); CP155, 75 m (3). CORINDON II: station 263, strait of Makassar, 1°56.8' S, 119°16.7' E, 80 m (1).

RECORDS. — HOEK 1907a: 21, 19 stations East Indies, 16-120 m; NILSSON-CANTELL 1921: 268, Japan, 135 m; NILSSON-CANTELL 1927: 762, Persian Gulf; NILSSON-CANTELL 1934a: 60, Malaysia, 73 m; BROCH 1931: 40, Kei Islands, 38-50 m; HIRO 1937a: 414, Japan, 24 m (*i. e.* Persian Gulf, Malaysia to Japan, 16-135 m). On hydroids, etc.

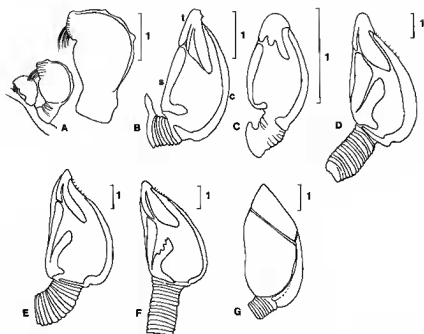


FIG. — 1. A, *Heteralepas japonica* MD32, CP60. B, *Octolasmis orthogonia* MD32, CP172. C, ditto, juvenile. D, *Octolasmis nierstraszi* MD32, CP127. E, ditto, CP155. F, ditto. G, *Glyptelasma annandalei* MD32, FA137. Scales in mm. Capitular plates — c, carina; s, scutum, t, tergum.

REMARKS

The bilobed tergum and narrowly split scutum clearly distinguish this species, but it is apparent that there is variation in the shape of the basal arm of the scutum, in some cases making the scutum trilobed.

Megalasma (*Glyptelasma*) annandalei (Pilsbry, 1907)

(Fig. 1 G)

MATERIAL. — MD32/La Réunion: FA137, 980 m (3 specimens).

RECORDS. — PILSBRY 1907a: 89, off Cape Hatteras, 1 406 m.

REMARKS

The rectangular lateral aspect of the capitulum, imparted by the non-inflected occludent edge of the scutum, distinguishes this species from others in the genus. This record extends the known distribution of *M. annandalei* from the Atlantic Ocean to the Indian Ocean.

Family OXYNASPIDIDAE Pilsbry, 1907

DISCUSSION

There are 20 known species of *Oxynaspis*, they are listed below in order of decreasing capitular coverage by the shell plates, with depth and host species where recorded:

<i>O. connectens</i> Broch, 1931:	Kei Islands	245 m	siliceous sponge
<i>O. celata</i> Darwin, 1851	Madeira		<i>Aphanipathes woolastoni</i>
<i>O. c. hirtae</i> Totton, 1940	West Indies		<i>Paranipathes hirta</i>
<i>O. alatae</i> Totton, 1940	Mauritius		<i>Aphanipathes alata</i>
<i>O. cancellatae</i> Totton, 1940	Kei Islands		—
<i>O. indica</i> Annandale, 1910	IWP	50-1400 m	<i>Aphanipathes</i> sp.
<i>O. gracilis</i> Totton, 1940	West Indies		<i>Antipathes aperta</i>
<i>O. pacifica</i> Hiro, 1931	Japan	128-365 m	<i>Antipathella gracilis</i>
<i>O. terranova</i> Totton, 1923	New Zealand	189 m	<i>Antipathes</i> sp.
<i>O. rossi</i> Newman, 1972	California	55-183 m	<i>Antipathes lilliei</i>
<i>O. pulchra</i> Nilsson-Cantell, 1934a	Timor	549 m	<i>Antipathes</i> sp.
<i>O. patens</i> Aurivillius, 1894	West Indies	135 m	antipatharian
<i>O. granti</i> Totton, 1940	Penang		<i>Antipathes</i>
<i>O. aurivilli</i> Stebbing, 1900	East Africa	10-453 m	—
	Japan	100 m	<i>Arachnopathes</i>
<i>O. michi</i> Zevina, 1983	Nasca Ridge	240 m	antipatharian
<i>O. bocki</i> Nilsson-Cantell, 1921	Japan	230 m	—
	Philippines	187 m	horny coral
<i>O. faroni</i> Totton, 1940	Red Sea	20 m	antipatharian
<i>O. acapitula</i> n.sp.	Réunion	120 m	<i>Antipathes lentispina</i>
<i>O. floridana</i> Pilsbry, 1953	Florida	92-110 m	—
<i>O. reducens</i> Foster, 1982	Hong Kong	12 m	antipatharian
			<i>Antipathella japonica</i>
			<i>Cirripathes anguia</i>

Current understanding of this diverse genus has been hampered by a lack of appreciation of the host relationship. A closer identification of the host species (following the notable biotaxonomic work of TOTTON, 1923), may provide correlation between host specificity, conenchyme protection and shell plate reduction.

***Oxynaspis alatae* Totton, 1940**

(Fig. 2 A)

MATERIAL. — MD32/La Réunion: FA40, 150 m (1 specimen).

RECORDS. — TOTTON 1940: 470, Mauritius.

REMARKS

A distinctive species, well-endowed with spikes of the host antipatharian (*Antipathes alata*). The carina is right-angularly bent, with a very wide lower part slung back towards the peduncle.

Oxynaspis indica Annandale, 1910

(Fig. 2 B, C)

MATERIAL. — MD32/La Réunion: CP43, 75 m (3 specimens).

RECORDS. — ANNANDALE 1910: 69, Burma, 31 m and Bengal, 37 m; BROCH 1931: 34, JOLO, 50 m; TOTTON 1940: 474, East Africa, Mauritius; FOSTER 1978: 22, New Zealand, 50-110 m. As forma *japonica*, BROCH 1922: 275, Japan, 137 m. As forma *novazelandica*, BROCH 1922: 275, Australia, 293 m (*i. e.* Indo-West Pacific, 50-1 400 m).

REMARKS

This is a compact species, with capitulum and peduncle well enveloped with host antipatharian coenosac bearing short spikes outwardly. Of the red-tinged plates, the tergum fits snugly between the carina and scutum, and the scutum is set only slightly apart from the carina. The carina is bent 0.5-0.75 the distance down from the apex, which feature sets it apart from *Oxynaspis celata* of the Atlantic Ocean (FOSTER 1978). However, ZEVINA (1982: 31) maintains ANNANDALE's original subspecific status of *indica* with *celata*.

Oxynaspis gracilis Totton, 1940

(Fig. 2 D)

MATERIAL. — MD32/La Réunion: DR90, 65 m (1 specimen).

RECORD. — TOTTON 1940: 472 West Indies.

REMARKS

This species is notable because of the square lower part of the scutum, with the umbo central on the occludent edge and set slightly back from it. The scutum is separated from the carina. The type specimens described by Totton are seated on *Antipathes gracilis*. The present specimen is detached from its host.

Oxynaspis acapitula nov. sp.

(Fig. 2 E-K)

MATERIAL. — MD32/La Réunion: CP172, 120 m (2 specimens: holotype MNHN Ci 2130, paratype MNHN Ci 2131).

DESCRIPTION OF HOLOTYPE

6.2 mm total length (fig. 2 E, F); capitulum and peduncle contiguous, with thick, dark, investing integument; shell plates (on clearing the integument) widely spaced. Carina narrow,

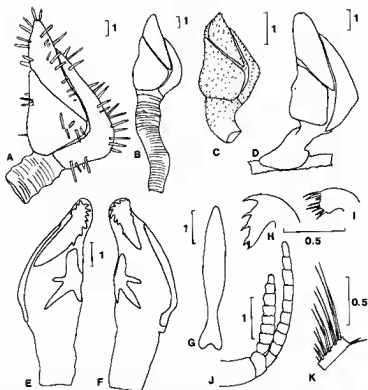


FIG. 2. — Oxynaspidae: A, *Oxynaspis alatae* MD32, FA40. B, *Oxynaspis indica* MD32, CP43. C, ditto, juvenile. D, *Oxynaspis gracilis* MD32, FA40. E-K, *Oxynaspis acapitula* nov. sp. MD32, CP172; E, F, left and right views of holotype, valves by transparency; G, carina, dorsal view; H, mandible; I, maxillule; J, cirrus I; K, intermediate segments cirrus VI. Scales in mm.

umbo close to base. Tergum with apex projecting over the orifice, umbo set back from edge, and apical/occludent border projecting in a series of sprocket-like teeth. Scutum also with umbo set back from medial border, and of 4 arms; the continuous tergal and rostral arms with barely serrated occludent edges, and the other 2 arms projecting towards the mid-part and base of the carina, respectively.

Mandible quadridentoid, with short row of spines at lower angle. Maxillule without a protuberant lower angle, spines at both upper and lower angles equal in length. Cirrus I anterior ramus shorter than posterior ramus, and with segments only slightly wider. Cirri II- VI similar, with subequal rami, and with the following segment numbers, anterior ramus first:

I	II	III	IV	V	VI
7,9	10,11	12,13	12,13	12,13	12,13

Intermediate segments of cirrus VI with 5 pairs of setae on anterior edge. Penis 4 times the length of pedicle of cirrus VI. Caudal appendages and prosomal filaments absent.

REMARKS

This species is close to *O. faroni* Totton. It differs in the non-demarcated capitulum/peduncle junction, and the four-armed rather than three-armed scutum. It is also similar to *Oxynaspis reducens* Foster but the capitulum of *O. acapitula* is more slender and its scutum, like *O. faroni*, does not possess a horizontal arm.

Family SCALPELLIDAE Pilsbry, 1907

Subfamily CALANTICINAE Zevina, 1978

***Calantica pusilla* Utinomi, 1970**

(Fig. 3 A, B)

MATERIAL. — MD32/La Réunion: FA39, 70 m (1 specimen); CP172, 110 m (1, on red gorgonian).

RECORD. — UTINOMI 1970: 159, Japan, 35-100 m on *Anthogorgia bocki*.

REMARKS

The larger of these specimens (CP172) may be younger, because of its relatively reduced armature. These little barnacles are like UTINOMI's specimens, but possess dwarf males in the interscutal niche. This record extends the geographic range to Indo-West Pacific.

***Calantica pollicipedoides* (Hoek, 1907)**

(Fig. 3 C)

MATERIAL. — MUSORSTOM 2 (Philippines): station 33, 13°32.3' N, 121°07.5' E, 135m (1 specimen).

RECORD. — Hoek 1907a: 60, New Guinea, 57 m; Barnard 1924: 12, South Africa, 24-165m; BROCH 1931: 10, Philippines, 100-190m.

REMARKS

The existence of 17 capitular plates, rather than 15 as in HOEK's holotype, is entirely explained by "the tendency towards multiplication of lower latera" (HOEK, 1907a; BARNARD, 1924) noted aberrations including an absence of peduncular scales. The extra rostrolatus in this specimen is consistent with the variation in shell armature as shown, for example, in *Calantica spinosa* (Quoy & Gaimard) and *Calantica spinilatera* Foster, as detailed by FOSTER (1978). This variability, however, is not seen in the type species, *Calantica villosa* (Leach); this and other species constantly have 3 lower latera on each side between the rostrum and subcarina.

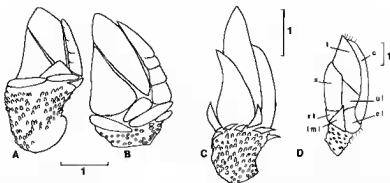


FIG. 3. — Scalpellidae: A, *Calantica pusilla* MD32, FA39. B, ditto MD32, CP172. C, *Calantica pollicipedoides* MUSORSTOM 2, Stn 33. D, *Arcoscalpellum triangulare* MUSORSTOM 2, Stn 33 (4mm cl). Scales in mm. Capitular plates — c, carina; cl, carinolatus; iml, inframedian latus; rl, rostromlatus; s, scutum; t, tergum; ul, upper latus. Scales in mm.

Subfamily SCALPELLINAE Pilsbry, 1907

DISCUSSION

There is a rather extraordinary diversity of 29 genera and at least 230 scalpelline species (as listed in ZEVINA, 1981) in which the capitulum has 14 plates of the general form shown in figures 3-8, and specifically named in figure 3. As well as the basic carina, terga and scuta, there is a small and often outwardly inconspicuous rostrum, an upper latus interposed between tergum, scutum, carina and lower latera on each side; and the lower latera composed of carinolatus, inframedian latus and rostromlatus. There is no subcarina. The plates sometimes incompletely cover the capitulum, may be variously reduced, and sometimes have the umbo displaced from the primary apical (proximal) position by subsequent apically directed growth zones. The subapical position of the umbo of the carina, upper latus and scutum of *Scalpellum scalpellum* has long been held as a distinctive character for a relatively small number of species, *Scalpellum* Leach, 1817 (*sensu stricto*).

This paper follows ZEVINA (1981) as close as possible, although the present writers believe that a clear phylogenetic division of the scalpellines is not yet to hand. The order of presentation of the species reflects possible trends in radiation: from a form (fig. 3) in which the carino- and rostromlatera are transversely elongate and the inframedian latus is broadly triangular; to a more elongate form (fig. 5) in which the carinolatus is higher than wide and the inframedian latus occupies all the space between the rostro- and carinolaterata, at least in juveniles; to forms in which the inframedian latus is much elongate with development of a subcentral umbo (fig. 6); to similar forms in which the upper margins of the scutum and/or the upper latus develop secondary growth zones (fig. 7A). These changes seem associated with slenderising of the capitulum and also decreasing overall size of the adult. The tendency towards reduced calcification of one or some of the plates is ontogenetically expressed, in some species, where calcification apparently fails to keep up with growth.

Trianguloscalpellum regium (Thomson, 1873)

(Fig. 6 K)

MATERIAL. — MD32 La Réunion: CP21, 4 030 m (3 specimens).

RECORDS. — THOMSON 1873: 347, and HOEK 1883: 106, North Atlantic, 5029-5212 m; GRUVEL 1920: 30, off Cape Finisterre, 2 779 m. Not PILSBRY 1907a: 28, off Chesapeake Bay, 3 740 m, = *T. gigas*, see below. As *molle* AURIVILLIUS 1898: 191, Azores 845-1 023 m; and GRUVEL 1920: 29, Azores, 4 020 m. As var. *ovale* HOEK 1883: 109, North Atlantic, 5 212 m. As var. *latidorsum* PILSBRY 1907a: 29, off New York, 1 812-2 940 m. (*i. e.* North Atlantic, 845-5 212 m).

REMARKS

This is a particularly handsome deep water species, enough so to compel THOMSON (1873) to publish a description of it in advance of HOEK's (1883) full account of the "Challenger" cirripedes. Despite HOEK's disclaimer, the illustrated *Nature* account of *S. regium* by THOMPSON (1873) is adequate to establish the species. With respect to the sexual condition, Wyville THOMSON and HOEK were clear there was no penis, yet PILSBRY (1907a) claimed it is "very long, and in its distal half quite slender", and ZEVINA (1981: 309) figures a penis too. These records and/or illustrations cannot be applied to *Trianguloscalpellum regium*.

Arcoscalpellum ?triangulare (Hoek, 1883)

(Fig. 3 D)

MATERIAL. — MUSORSTOM 2 (Philippines): Stn 33, 13°32.3' N, 121°07.5' E, 135 m (2 specimens).

RECORDS. — HOEK 1883: 130, Madagascar Basin, 1 092 m; ZEVINA 1964: 253, Southern Ocean, 370-500 m (*in* ZEVINA 1981: 326).

REMARKS

It is with some doubt that these 2 small specimens are assigned to this species. The inframedian latus is proportionally larger, and the carinolatus shorter than in HOEK's figure, but these may be growth features.

The shape of the carinolatus differs from the foregoing species in that it develops a distinct carinal margin and is as high as wide. In this respect it resembles all the following scalpelline species.

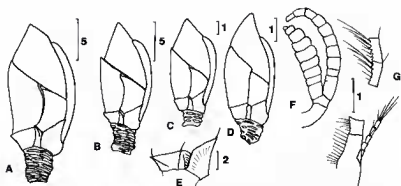


FIG. 4. — Scalpellinae: A-H *Arcoscalpellum truncatum* A, MD32, CP146 (15.0mm cl). B, ditto, (13.0mm cl). C, ditto (8.0mm cl). D, ditto 4.8mm cl). E, detail of inframedian latus MD32, CP103 (16.0mm cl). F, MD32, CP146 (12.5mm cl) cirrus I. G, ditto, intermediate segments cirrus VI. H, ditto, pedicel cirrus VI and caudal appendage. Scales in mm.

***Arcoscalpellum truncatum* (Hoek, 1883)**

(Fig. 4 A-H; 5)

MATERIAL. — MD32/La Réunion: CP103, 2 970 m (2 specimens); CP146, 2 850 m (11).

RECORDS. — HOEK 1883: 92, off New Guinea, 2 560 m; ZEVINA 1973: 846 (cited in ZEVINA 1981: 334), 2 520-3 060 m.

REMARKS

This is an easily recognised scalpelline; the plates are finely and doubly striated, and remain approximate through ontogeny with secondary growth zones forming tergo-apically on the upper latus, and towards the upper latus on the inframedian latus. The cirri are progressively longer posteriorly (fig. 4), cirrus II notably intermediate in length between posterior ramus of cirrus I and both rami of cirrus III.

***Amigdoscalpellum praeceps* (Hoek, 1907)**

(Fig. 6 A-E)

MATERIAL. — MD32/La Réunion: DC14, 2 175 m (1 specimen); CP103, 2 970 m (1); CP146, 2 850 m (9); DC163, 1 660 m (1).

RECORD. — HOEK 1907a:114, East Indies, 411 m.

REMARKS

This is a slender species with lightly sculptured plates which with growth, show a widening of the carinal tergal interspace (starting at about 10 mm capitulum length), and reduction of

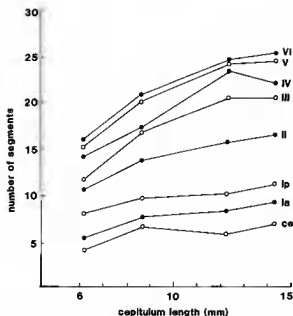


FIG. 5. — Scalpellinae: *Arcoscalpellum truncatum* MD32, CP146: Mean number of segments per rami as a function of size of specimen, one specimen at each size.

the inframedian latus from full occupation of the space between the rostro- and carinolatera to about 0.2 times it. The inframedian latus is displaced outwards in specimens greater than 26 mm in cephalum length.

Dissection of 4 specimens from CP146 (6-28 mm cephalum length) revealed complementary males in the 19 and 28 mm specimens, a uniaarticulate caudal appendage in all, and the following mean numbers of segments per rami of the cirri:

cl (mm)	Ia	Ip	II	III	IV	V	VI
13	8	10	17	21	21	22	23
19	10	12	22	25	26	27	28
28	10	14	24	25	29	30	30

These values are comparable to those of *A. michelottianum*, size for size, except for cirrus II which is more intermediate between cirrus Ip and cirrus III in *A. praeceps*.

HOEK (1907a) believed *A. praeceps* to be closely related to *Amigdoscalpellum striatum* (Gruvel), which ZEVINA (1981) placed in synonymy with *Amigdoscalpellum rigidum* (Aurivilius), both from near the Azores. Comparing GRUVEL's (1902) illustration of *A. striatum*, and not ZEVINA's reproduction of it, there is much to commend this. The most notable feature is the faintly sinuous occludent margin of the scutum, not convex as in ZEVINA's figure, and the rostralatus is squarer in outline than in ZEVINA's figure. In these respects, *A. praeceps* approaches *A. rigidum*. A synonymy of *A. praeceps* with *A. rigidum* would extend the recorded distribution from the East Indies into the North Atlantic. But the proportions of the occludent edges of the rostralatera and carinolatera prevent such a synonymy at this stage.

***Amigdoscalpellum mamillatum* (Aurivillius, 1898)**

(Fig. 6 F)

MATERIAL. — MD32/La Réunion: CP105, 1 850 m (1 specimen).

RECORDS. — AURIVILLIUS 1898: 191 and GRUVEL 1920: 21, Azores, 4 020 m, off Portugal, 4 261 m. As *semisculptum* Pilsbry 1907a: 62, Gulf of Mexico, 512 m; BROCH 1953: 7, Iceland, 1 848 m.

REMARKS

This delicately sculptured barnacle, with a narrow inframedian latus that almost reaches the lower angle of the upper latus, has previously been known only from the Atlantic Ocean. This specimen extends its range into the Indian Ocean.

***Verum? minutum* (Hoek, 1883)**

(Fig. 6 G)

MATERIAL. — MD32/La Réunion: CP105, 1 850 m (3); CP150, 3 520 m (2).

RECORDS. — HOEK 1883: 113, South East Pacific, 2 652 m; STUBBINGS 1936: 28, off Zanzibar, 802 m.

REMARKS

A small, slender, non-hirsute scalpelline with smooth, non-striated plates, and faint growth ridges. Scutum and upper latus elongate, without secondary growth flanges. Carina slightly bowed in upper part. Tergum elongate, apex not curved. Carinolatus only slightly higher than wide. Rostrolatus quadrangular, with slight convexity on occludent margin. Inframedian latus very narrow, slightly wider near the upper extremity, umbo apical (unlike other species in *Verum*), and with very short scutal and upper latus margins. The apex of the inframedian latus is club-shaped and tipped towards the rostral margin, and displaced slightly from it in larger (> 5 mm) specimens.

The appendages have not hitherto been described. The labral lip is lined with a row of conical teeth. Mandible tridentoid. Maxillule with 2 large and 2 small spines at upper angle, 1 large and 2 small spines at lower angle. Maxillule without excretory papilla. Intermediate segments of anterior ramus cirrus I 1.5 times the width of posterior ramus. Mean segment counts as follows:

cl (mm)	Ia	Ip	IIa	IIp	III	IV	V	VI	ca
4.8	7	9	12	13	16	17	17	17	4
3.6	6	8	10	11	13	13	14	14	3
2.3	5	7	7	9	9	10	11	11	1

Intermediate segments of cirrus VI with 4 pairs of setae on anterior edge; not hypolaspid. Some of the intermediate segments of posterior rami with a seta midway on posterior edge. Caudal appendages slightly longer than pedicle cirrus VI in larger specimens, minute in the smaller.

Verum proclive (Hoek, 1907)

(Fig. 6 H)

MATERIAL. — MD32/La Réunion: DR62, 710 m (1 specimen); CP146, 2 850 m (1).

RECORD. — HOEK 1907a: 103, East Indies, 655 m.

REMARKS

All essential features of the CP146 barnacle agree with the description given by HOEK (1907a). The smaller specimen from DR62 is hesitantly assigned to the same species.

Weltnerium poculum (Hoek, 1907)

(Fig. 6 I, J)

MATERIAL. — MUSORSTOM 2 (Philippines): Stn 33, 13°32.3' N, 121°07.5' E, 135 m (2 specimens).

RECORD. — HOEK 1907a: 100, East Indies, 918 m; ROSELL 1989: 13, Philippines, 441-550 m.

REMARKS

This species has smooth plates, a distinctly pentagonal upper latus, a carinolatus with a very low placed umbo, and a wine-glass shaped inframedian latus ("irregularly" so, according HOEK (1907a): "the right inframedian latus shows by no means the same shape as on the left"). The left is the one that is figured by HOEK (1907a, pl. VIII fig. 4) and reproduced by ZEVINA (1981, fig. 147). The two specimens from the present collection illustrate how the inframedian latus and carinolatus elongate with growth. ROSELL's (1989) largest specimen (11.5 mm cl) also shows interspaces between carina and tergum, carinolatus and base of carina, and inframedian latus and rostralatus. ROSELL (1989) gives descriptions of appendages.

Annandaleum laccadivicum (Annandale, 1906)

(Fig. 7 D)

MATERIAL. — MD32/La Réunion: DS78, 1 200 m (3 specimens).

RECORDS. — ANNANDALE 1906: 393 and 1913: 235, northern Indian Ocean, 616-1 280 m; CALMAN 1918: 124, Java-Australia, 732 m; STUBBINGS 1936: 26, Zanzibar, 439-802 m; HIRO 1933: 31, Japan, 364 m; NILSSON-CANTELL 1938: 25, Gulf of Oman. As *subflavum* ANNANDALE 1906: 397. As *polymorphum* HOEK 1907a: 80, East Indies, 397-794 m. As *mollicum* PILSBRY 1911: 68, Japan, 446 m.

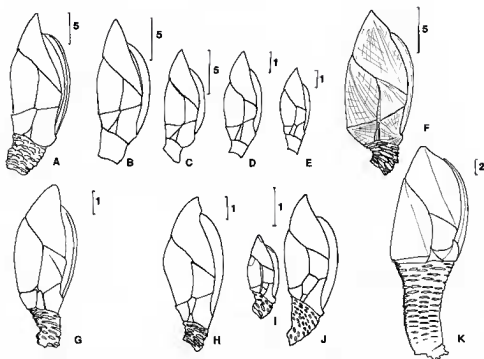


FIG. 6. — Scalpellinae: A-E *Amigdoscapellum praeceps* A, MD32, CP146 (26.8mm cl). B, ditto, (15.0mm cl). C, ditto (12.5mm cl). D, ditto, (6.0mm cl). E, ditto, (4.8mm cl). F, *Amigdoscapellum mamillatum* MD 32, CP 105 (19.2 mm cl). G, *Verum minutum* MD 32, CP 150 (5.5 mm cl). H, *Verum proclive* MD32, CP146 (6.0mm cl). I, J, *Welnerium poculum* MUSORSTOM 2, Stn 33 (juvenile and 3.4mm cl). K, *Trianguloscapellum regium* MD32, CP21 (37.8 mm cl). Scales in mm.

REMARKS

This species is notable for the basally placed umbos of the carinolatus and inframedian latus, which tend to project laterally at the base of the capitulum over the peduncle. The inframedian latus is relatively wide in the upper part, with a long scutal margin. Previous authors have noted considerable variation in this species.

Planoscapellum distinctum (Hoek, 1883)

(Fig. 7 A-C)

MATERIAL. — MD32/La Réunion: CP105, 1 850 m (5 specimens).

RECORDS. — HOEK 1883: 111 and HOEK 1907a: 83, East Indies, 1 301-2 218 m; NILSSON-CANTELL 1927: 750, Java, 1 440-2 745 m.

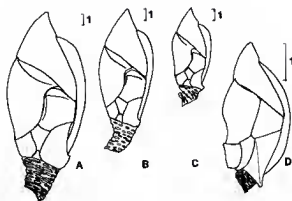


FIG. 7. — Scalpellinae: A *Planoscalpellum distinctum* MD32, CP105 (13.1 mm cl). B, ditto, (10.1 mm cl). C, ditto, (7.0 mm cl). D, *Annandaleum laccadavicum* MD32, DS78 (5.0 mm cl). Scales in mm.

REMARKS

HOEK (1907a) drew attention to “fault of the lithograph” of the “Challenger” illustration (HOEK 1883, pl. VI fig. 10), giving appearance of rather heavy sculpture on the shells (replicated by ZEVINA 1981: 186). A fault with the “Siboga” illustration (HOEK 1907a, pl. VII fig. 12) is that the umbo of the scutum is quite out of place. NILSSON-CANTELL (1927) amplified the descriptions for this “easily identified” but apparently poorly documented barnacle.

The largest of the specimens of this lot is 13.1 mm capitulum length, in which the plates are quite approximate, and with prominent secondary growth flanges on the upper edges of the scutum and upper latus. Any tendency for the plates to diverge in larger specimens is not as pronounced as shown in ZEVINA’s (1981) reproduction of HOEK’s figure, nor are the regularity of the peduncular scales necessarily so clear (see HOEK 1907a: 84).

Verum constrictum nov. sp.

(Fig. 8 A-J)

MATERIAL. — MD32/La Réunion: CP146, 2 850 m (1 specimen, holotype MNHN Ci 2134); CP150, 3 520 m (1).

DESCRIPTION OF HOLOTYPE (CP146)

13.8 mm capitulum length: peduncle short, with irregular rows of wide scales. Capitulum with 14 plates, finely striated, approximate. Tergum triangular, occludent margin convex, carinal margin notched for reception of carina. Scutum narrowly quadrangular, lateral margin deeply notched for reception of upper latus. Upper latus pentagonal, apex displaced below

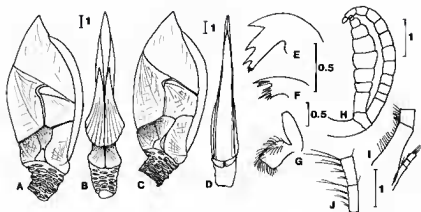


FIG. 8. — Scalpellinae: *Verum constrictum* nov. sp.: A, MD32, CP146 (13.8 mm cl). B, ditto, rostral view. C, MD32, CP150 (13.0 mm cl). D, ditto, carinal view. E-J, holotype (fig. 8A); E, mandible; F, maxillule; G, maxilla; H, cirrus I, I, pedicle cirrus VI and caudal appendage; J, intermediate segments posterior ramus cirrus VI. Scales in mm.

scutal notch, and with secondary flange occupying the space to tergum. Carina simply bowed, broad basally. Carinolatus irregularly quadrangular, twice as high as wide, carinal margin projecting and extending beyond base of carina. Rostrolatus pentagonal in side view, whole plate concaved to apex up under scutum to give a narrow waist in rostral view. Rostrum minute, between apices of rostrolatera. Inframedian latus hour-glass shaped, upper portion larger, with wide margins towards upper latus and scutum, lower part slightly bowed inwards to rostrolatera.

Mandible tridentoid. Maxillule simple, with 3 stout spines at upper corner. Maxillule with prominent excretory papilla. Cirrus I with medial segments twice as broad as those of posterior ramus. Mean segment counts, anterior ramus first:

I	II	III	IV	V	VI	ca
8,12	17,12	23,23	25,26	27,25	28,26	3

Caudal appendage half length of basal segment of pedicle of cirrus VI. Segments of posterior cirri with 4 pairs of setae on anterior edge, the distal pair twice as long as the subdistal pair. Penis absent.

REMARKS

This species is most notable for the constriction of the capitulum below the scuta. Without this feature, and in lateral views, it resembles *V. proximum* (Pilsbry), *V. virgatum* (Hock), even *V. striolatum* (Sars), but because of the constricted base of the capitulum it cannot be equated to any of these. By the shape of the inframedian latus, and ZEVINA's (1978b) assignment of the above species, it too is assigned to *Verum*.

Family VERRUCIDAE Darwin, 1854

DISCUSSION

Verrucids are asymmetrical sessile barnacles having a shell wall composed of carina, rostrum, fixed scutum and fixed tergum, and an operculum of movable tergum and movable scutum. Nomenclature of these plates is shown in fig. 9. Verrucids can be either "left-handed" or "right-handed", apparently by chance. There are 81 named species in the family (BUCKERIDGE, 1994).

KEY TO GENERA OF THE VERRUCIDAE
(from BUCKERIDGE, 1994)

- | | |
|---|------------------------|
| 1. Rostral and carinal apices marginal | 2 |
| - Rostral apex only removed from margin..... | <i>Rostratoverruca</i> |
| - Rostral and carinal apices removed from margin..... | <i>Brochiverruca</i> |
| 2. Myophore present on fixed scutum | 3 |
| - Myophore absent on fixed scutum..... | 4 |
| 3. Operculum nearly vertical to base..... | <i>Cameraverruca</i> |
| - Operculum nearly parallel to base..... | <i>Metaverruca</i> |
| 4. Operculum nearly vertical to base..... | 5 |
| - Operculum nearly parallel to base..... | <i>Verruca</i> |
| 5. Not embedded in sponge | <i>Alliverruca</i> |
| - Embedded in sponge | <i>Spongoverruca</i> |

Verruca trisulcata Gruvel, 1900

(Fig. 9 A-B)

MATERIAL. — La Réunion/MD32: DC10, 980 m (3); FA137, 980 m (2); CP140, 1690 m (1).

RECORDS. — GRUVEL 1900*b*: 243; 1902: 96; 1920:44, Azores, 998 m. GRUVEL 1912*b*: 348, Cape Spartel (Straits of Gibraltar), 622 m. *As imbricata* GRUVEL 1900*b*: 244, 1902: 105, Azores, 441 m. *As striata* Gruvel 1900*b*: 244; 1902: 98, Cape Verde I, 633 m. *As radiata* Gruvel 1900*b*: 262, 1902: 94, Canaries, 912 m.

REMARKS

Shell forms range from low splayed (half as high as wide) to quite upstanding (higher than wide) posture. The number of interlocking ribs between the movable tergum and scutum, and between the carina and rostrum, increases with growth from 1 in juveniles to 4 in specimens about 6 mm rostrocarinal length. A characteristic feature of the shell is the particularly wide

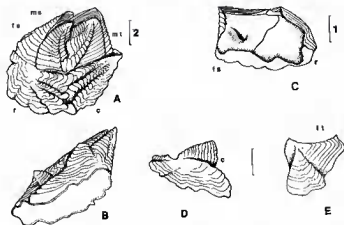


FIG. 9. — Verrucidae: A-B *Verruca trisulcata*: A, MD 32, DC10 (9.8 mm rcl). B, carinal view, specimen A. C-E *Metaverruca recta*: C, interior view of fixed scutum and rostrum, showing myophore on fixed scutum (3.4 mm rcl) MD32, DR108. D, carina, outer view, ditto. E, fixed tergum, outer view. Scales in mm. Shell plates: c, carina; fs, fixed scutum; ft, fixed tergum; ms, movable scutum; mt, movable tergum; r, rostrum. rcl = umbos of rostrum to carina length.

superior rib on the rostrum. The apices of the rostrum and carina are never turned inwards. The “back” view (*i. e.* of the fixed tergum and scutum) is highly variable; tall with easily discernable alae and radial growth areas, or squat and contorted depending on irregularities of substratum. Movable scutum apex curved over the superior articular groove, with a moderately deep apical pit internally. Movable tergum broadly quadrangular, 1.5 times the width of scutum, lower angle protruding as apical ridge.

Mandible tridentoid, with a pectinate lower edge. Maxillule with an irregular cutting edge, the lower angle protuberant. (These features seem common to verrucids.) Cirrus I anterior ramus just over 0.5 times the length of posterior ramus. Cirrus II anterior ramus less than 0.5 times the length of posterior ramus. Cirrus III-VI with subequal rami. Caudal appendage about 0.66 times the length of cirrus VI. Caudal appendage 0.5 times the length of cirrus VI.

These specimens were initially identified as *V. striata*, distinguished from *V. trisulcata* on the basis of the more frilly sculpturing of the growth ridges on the shell compartments, and both of the movable opercula have less prominent apical ridges above the main, central rib. The appendages, and other points of shell mentioned above, could not be distinguished.

It seems unavoidable that *trisulcata*, *imbricata* and *striata* are synonymous. Further, *radiata* is indistinguishable too. Because the numbers of articular ribs on the movable tergum is not constant, nor is the overall shell shape, it may be that *V. grimaldi* Gruvel, 1920 from off Madeira Is, *V. entobapta* Pilsbry, 1916 from off Florida, and *V. macani* Stubbings, 1936 from off Zanzibar could be the same species.

Verruca sinuosa nov. sp.

(Fig. 10 A-K)

MATERIAL. — MD32/La Réunion: FA137, 980 m (3 specimens: holotype MNHN Ci 2136; paratypes MNHN Ci 2137).

DESCRIPTION

Shell compact, weakly sculptured even though the shell is irregular when seated on an echinoid spine. Rostrum with ledge towards the movable scutum above the superior articular ridge; lower articular ridges wider than the upper one. Movable tergum and scutum each with barely prominent apical ridge, with wavy interarticular ridges above. The whole suture between the movable tergum and carina on the one side, and the movable scutum and rostrum on the other, forms a conspicuous and continuous sinuous line. Fixed scutum with apex curved towards fixed tergum.

Mandible tridentoid, with denticles on upper edges of 3rd and 4th teeth. Maxillules with 2 stout spines at upper angle, and cluster of smaller spines on protuberant lower angle. Cirrus I with anterior ramus just longer than posterior ramus, segments equal in width. Cirrus II with anterior ramus just shorter than posterior ramus. Cirrus III with anterior ramus shorter than posterior ramus. Mean numbers of segments per cirri as follows, anterior ramus first:

I	II	III	IV	V	VI	ca
10,8	9,10	15,20	22,24	27,27	28,29	7

Caudal appendages as long as pedicle of cirrus VI. Intermediate segments of cirrus VI with 3 pairs of setae on anterior edge, the proximal pair very small.

REMARKS

This barnacle resembles *V. nitida* Hoek in general form, but the scutum is proportionally wider and the rostrum bears a ledge above the main articular ridge. The caudal appendage is short, compared with that described in *V. nitida* by ROSELL (1981: 297) and BUCKERIDGE (1994: 102). There is also some resemblance to *V. regularis* Nilsson-Cantell, and to *V. sulcata* Hoek, but again some details preclude identification with these species. All these species are within the *V. gibbosa* complex; NILSSON-CANTELL (1928) felt there was room for synonymy, but NEWMAN & ROSS (1971: 137) felt there may be undue synonymy.

Verruca cookei Pilsbry, 1927

(Fig. 10 L)

MATERIAL. — MD32/La Réunion: PL53, 0-10 m (2 specimens).

RECORDS. — PILSBRY 1927: 308, littoral of Hawaii; HENRY 1957: 28, Tuamotu Islands, littoral; FOSTER 1990: Guam, littoral. The Philippine record of ROSELL (1981: 299) is *V. recta*. (BUCKERIDGE, 1994: 116).

REMARKS

These are very small barnacles, quite depressed like the form of *V. stroemia* and *V. laevigata* from littoral habitats, and notable by the growth ridges being lined with small beading.

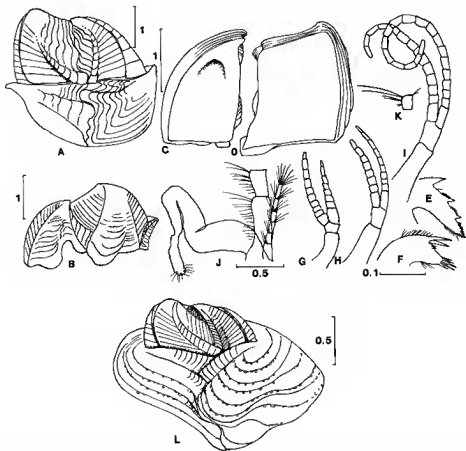


FIG. 10. — Verrucidae: *Verruca sinuosa* nov. sp. MD32, FA137: A, B, "front" and "rear" views of same specimen, off echinoid spine (4.0 mm rcl). C, D, inner views of scutum and tergum of same specimen. E, mandible; F, maxillule; G, cirrus I; H, cirrus II; I, cirrus III; J, pedicle cirrus VI, penis and caudal appendage; K, intermediate segment cirrus VI. L, *Verruca cooki* MD32, PL53. Scales in mm; E and F to same scale; G-K to same scale.

Verruca quadrangularis Hoek, 1883

(Fig. 11 A-O)

MATERIAL. — MD32/La Réunion: DC64, 1 180 m (36 specimens); DS78, 1 200 m (3); CP105, 1850 m (1); DR108, 1 230 m (21); FA137, 980 m (1); CP146, 2 850 m (1).

RECORDS. — HOEK 1883: 140, south of Madagascar, 3 460 m; GRUVEL 1920: 40, Madeira Is, 2380 m; not ROSELL 1989: 24, Philippines, 682-770 m (needs naming). As *obliqua* Hoek, 1883: 143, off Spain, 2 782 m. As *longicarinata* Gruvel 1900b: 242; 1902: 91, Sargasso Sea, 3432 m; ZEVINA 1987: 1305, off Somalia, 3 425 m. As *hoekii* Pilsbry 1907a: 113 and PILSBRY 1916: 41, Leeward Is, 907 m; ZEVINA 1975: 234, West Indies, 1 060 m.

REMARKS

This is a small, white, purse-like, faintly-sculptured verrucid, mostly with the lid held nearly vertical to the plane of the base, with barely defined articular ridges between rostrum and carina in the upper part. In 'front' view the rostrum is distinctly quadrangular, as broad or broader than long. The apex of rostrum mostly curves in a broad arc below the movable scutum but in more erect specimens it forms a straight diagonal to the basal junction of rostrum and carina. Apex of carina often projecting (*longicarinata*). Articular ridge between operculum and shell forms a shallow "v" or concave curve. The movable scutum has a barely defined diagonal rib. The movable tergum has a moderately defined central rib. Both opercula without ribs above the diagonals.

There is considerable variation in the relative proportions of the shell dimensions, e.g. overall height (fixed tergum) to rostrocarinal suture height — which determines the angle of the operculum — varies from 1.0 (*i. e.* parallel to base) to 1.9 (about 45 degrees to base). The shell itself varies from 0.5 times as high as wide to 1.5 times as high as wide. Some of these variations are shown in the figure 11. When seated on a confined substratum, the shell in 'front' view can be vase-like (*obliqua*), but on a broad substratum it can be quite square.

Cirrus I with anterior ramus just longer than posterior ramus. Cirrus II with anterior ramus shorter than posterior ramus. Cirri III-VI with subequal rami. Mean numbers of segments in cirri of two specimens as follows, anterior ramus first:

rcl (mm)	I	II	III	IV	V	VI	ca
3.6	8,8	5,7	9,9	11,12	15,14	16,17	6
4.0	8,8	6,9	11,11	16,17	16,17	17,19	10

Caudal appendages twice the length of pedicle of cirrus VI. Intermediate segments of cirrus VI with 2 pairs of setae on anterior edge.

This is a common Atlantic Ocean verrucid; the present material extends its known range into the Indian Ocean.

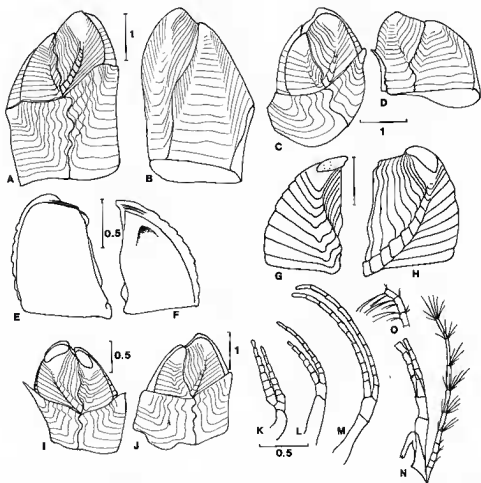


FIG. 11. — Verrucidae: *Verruca quadrangularis*: A, B, 'front' and 'rear' views tall specimen (2.5 mm cl) MD32, DR102. C, D, ditto squat specimen (2.3 mm cl) MD32, DR102. E, F, inner view tergum and scutum (of 2.5 mm specimen) MD32, DR102. G, H, outer views, ditto. I, 'front' view juvenile (1.2 mm cl) MD32, DC64. J, ditto, (2.5 mm cl) MD32, DR108. K, cirrus I; L, cirrus II; M, cirrus III; N, pedicle cirrus VI, penis and caudal appendage; O, intermediate segment cirrus VI; all of same specimens (2.7 mm cl) MD32, DR108, and all to same scale. Scales in mm.

Metaverruca recta (Aurivillius, 1898)

(Fig. 9 C-E)

MATERIAL. — MD32/La Réunion: DR108, 1 230 m (1); CP144, 620 m (1).

RECORDS. — AURIVILLIUS 1898: 195, and GRUVEL 1920: 46 (for synonymy with *linearis*), Azores, 861-1 385 m; Southward & Southward 1958: 637, Bay of Biscay, 329-1 774 m. *As sculpta* Aurivillius 1898: 197 and GRUVEL 1920: 41, Azores, 454 m; NILSSON-CANTELL 1929: 461 (for synonymy with *magna, recta, coraliophila, halotheca*), Scotland, 1326 m; BROCH 1931: 41, Kei Is, 345 m; FOSTER 1981: 352, Kermadec

Is, 501-1 180 m. *As magna* Gruvel 1901: 261; 1902: 109, Gulf of Gascoyne, 1 480 m; GRUVEL 1920: 50 (for synonymy with *capsula*). *As linearis* Gruvel 1900b: 243 and GRUVEL 1902: 107, Azores, 960-2018 m. *As halothea* Pilsbry 1907b: 188, Hawaii, 1670 m; PILSBRY 1916: 46, Hawaii, 417-430 m; FOSTER 1978: 69, New Zealand, 252-896 m. *As capsula* Hoek 1913: 130, East Indies, 520-1 301 m; STUBBINGS 1936: 38, Zanzibar, 333 m. *As coraliophila* Pilsbry 1916: 21, Florida, Bahamas, 506-794 m; BUCKERIDGE 1994: 116 (for full synonymy, including synonymy with *sculpta*), New Caledonia, 320-2 110 m, Chesterfield Islands, 305-970 m, Loyalty Islands, 240-380 m, Wallis and Futuna Islands, 325-1300 m, Philippines, 668 m.

REMARKS

This is a widespread verrucid, from North Atlantic through Indian to North and South Pacific Oceans (it is also known fossil from the lower Miocene, BUCKERIDGE, 1983). *V. recta* is characterised by its low compact form, with the apices of the rostrum and tergum set in from the basal margin (*i. e.* the shell is conical rather than splayed), with the upper ribs between the rostrum and carina very wide, mostly 2 sometimes 3 of them; by the edge of articulation of the movable plates forming a straight line between the apices of the rostrum and carina; by the general D-shape of the orifice; by the operculum being held at an angle 45-90 degrees to the perpendicular depending on the nature of the substratum; by the scutal myopore, and by the generally large size of grown specimens for the genus (8-10 mm basal length). The appendages have been described in FOSTER (1978) and BUCKERIDGE (1994), notable is the shortness of the caudal appendages.

It is readily distinguished from two closely related species, *Metaverruca pacifica* Buckeridge and *Metaverruca defayae* Buckeridge, by possessing only three ribs on the movable scuta.

Metaverruca reunioni nov. sp.

(Fig. 12 A-J)

MATERIAL. — MD32/La Réunion: DC10, 980 m (4 specimens); DS109, 1 240 m (1); DC112, 780 m (1); DC136, 922 mm (136); FA137, 980 m (24); DC138, 1590 m (4); DS139, 1 600 m (2); DS149, 3510 (1).

HOLOTYPE. — DC136, the 2.9 mm rel specimen of figure 12A (MNHN Ci 2139). Paratypes from DC136, MNHN Ci 2140.

DESCRIPTION

Shell compact when seated on wide substratum, tulipiform when basally constricted. Carina and rostrum interlock by a single complete radial rib. An apically placed flange towards the opercular edge of the rostrum enables a straight line to occur between apices of the rostrum and carina. Fixed tergum and scutum with wide radial areas sweeping round to the carinal and rostral umbos respectively; suture between the parietes of fixed tergum and scutum rather narrow, with radial growth area of fixed tergum more or less clear. Fixed scutum internally

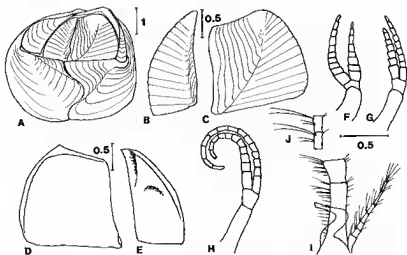


FIG. 12. — Verrucidae: *Metaverruca reumonii* nov. sp. MD32, DC136: A, top view (2.9 mm rcl). B, C, outer views scutum and tergum, specimen A. D, E, inner views ditto. F, cirrus I; G, cirrus II; H, cirrus III; I, pedicle cirrus VI, penis and caudal appendage; J, intermediate segments cirrus VI; all of a 1.7 mm rcl specimen, and all to same scale. Scales in mm.

with myophore. Operculum parallel to base. Movable tergum twice the width of movable scutum, with a single, barely defined ridge to basiscutal corner and projecting there as a small tooth. Movable tergum without an apico-basiscutal ridge, and with a very narrow area of upturned growth lines along the articular edge. Basal edges of shell compartments inflected. Base calcareous. Maximum size: 3.9 mm basal length, 2.0 mm apical rostrocarinal length. Cirrus I anterior ramus slightly longer than posterior ramus. Cirri II and III anterior rami slightly shorter than posterior rami. Cirri IV-VI with subequal rami. Mean number of segments per cirri in 3 specimens as follows, anterior ramus first:

rcl (mm)	I	II	III	IV	V	VI	ca
1.7	10,8	7,9	11,14	17,20	23,24	27,26	8
1.8	10,8	6,7	9,12	16,18	21,20	21,23	7
2.9	11,8	7,10	12,17	19,22	25,27	29,28	9

Caudal appendages just shorter than basal segment of pedicle of cirrus VI. Intermediate segments cirrus VI with 2 pairs of setae on anterior edge, the distal pair much the longer. Penis short.

REMARKS

This barnacle at first looked like young *M. recta*, but the consistent absence of specimens over 4 mm basal length suggested a different species. Comparison of the appendage segmentation, size for size, shows that they attain full or maximal segment complement at a

much smaller size than for *M. recta*. The relative sizes of the movable tergum and scutum differ (2 times and 1.5 times as wide in *M. reunioni* and *M. recta*, respectively). The low numbers of articular ridges between the rostrum and carina in *M. reunioni* is not in itself a useful character because juvenile *M. recta* can have as few, but the general inornateness of the exterior surfaces of *M. reunioni* contrasts with the wide ribs of *V. recta*.

The apparent restricted distribution of *M. reunioni* may be fortuitous, perhaps partly based on nonrecognition of the species elsewhere in its range, but it could also represent a restricted range of a species which looks like a neotonic development from a larger form in the metaverruroid stock. At Réunion Island it is evidently very abundant in places. At Stn DC136, apart from the intact specimens, the sample contains 40 ml of plate gravel made up largely of black basalt gravel and the white disarticulated plates of this species (petits cailloux à cirripèdes).

Rostratoverruca conchula (Hoek, 1913)

(Fig. 13 A-N)

MATERIAL. — MD32/La Réunion: FA40, 150 m (5 specimens); DC47, 215 m (1); DC128, 280 m (1); CP130, 380 m (16); DS131, 375 m (1); FA158, 525 m (3); CP172, 150 m (2); DS173, 270 m (1).

RECORDS. — HOEK 1913: 146, south of Timor, 520 m. As *murrayi* Stubbings 1936: 32, off Zanzibar, 310-330 m.

REMARKS

This form is notable for the considerable displacement of the rostral umbo from the margin to an almost central position in adult specimens, so that the rostrum becomes patelliform. The shells are rusty or vinaceous red, sometimes greenish, and occur in association with antipatharians and gorgonians. The carinal apex is marginal and projects beyond the fixed tergum, more so in larger specimens. There is a wide superior ridge on the carina that interlocks with the rostrum. The opercular plates interlock with 3 ribs. Movable scutum with longitudinal ribs interdigitating with ribs on rostrum. There is a small myophore on inside of fixed scutum. The different relative widths of the movable scuta and terga shown in figure 13B, C and figure 13E, F may reflect different species, but examination of all other details and range of specimens strongly suggests the FA40 specimens to be the same as the others.

Mean numbers of segments in cirri as follows, anterior ramus first:

rci	I	II	III	IV	V	VI	ca
ju	4,4	5,6	6,7	7,7	8,9	9,9	4
3.0	9,12	8,12	15,17	19,23	23,22	24,23	8
3.5	10,14	10,14	18,18	22,24	25,27	27,29	17

Caudal appendages longer than pedicle cirrus VI. Penis just longer than caudal appendages. Intermediate segments of posterior cirri with 3 pairs of setae on anterior edge.

R. conchula differs from *R. koehleri* (Gravel, 1907) from the Andaman Is, *R. intexta* (Pilsbry, 1912) from the Philippines, *V. krugeri* (Broch, 1922) from Tucura, and *R. sewelli*

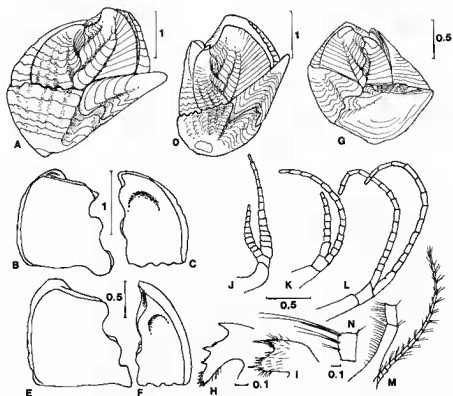


FIG. 13. — Verrucidae: *Rostratoverruca conchula*: A, MD32, FA40 (3.0 mm rel). B, C, inner views opercula of specimen A. D, MD32, FA158 (3.5 mm rel). E, F, inner views opercula specimen D. G, MD32, DC47 (1.8 mm rel). H, mandible; I, maxillule; J, cirrus I; K, cirrus II; L, cirrus III; M, pedicle cirrus VI and caudal appendage; N, intermediate segment cirrus VI; all of specimen D; H & I to same scale; J-M to same scale. Scales in mm.

(Stubbings, 1936) from off Zanzibar, by lack of small ribs superior to the main one on the carina. But considering the similarities, and that such variations in shell sculpturing may be habitat related, these may all prove to be synonymous. However, this group of verrucids is apparently epizoic, and there could be considerable consequent genetic distinctions.

Brochiverruca dens (Broch, 1931)

(Fig. 14 A-K)

MATERIAL. — MD32/La Réunion: FA118, 720 m (2 specimens, on *Oculina*-like coral).

RECORDS. — BROCH 1931: 47, Kei Is, on coral, 348 m, BUCKERIDGE 1994: 105, Indonesia, on coral, 356-368 m.

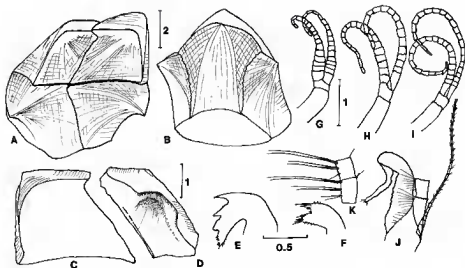


FIG. 14. — Verrucidae: *Brochiverruca dens* MD32, FA118: A, B, upper oblique and rear view (6.5 mm rcl). C, D, inner views tergum and scutum of same specimen. E, mandible; F, maxillule; G, cirrus I; H, cirrus II; I, cirrus III; J, pedicel cirrus VI, penis and caudal appendage; K, intermediate segments cirrus VI; all of specimen A; E & F to same scale; G-K to same scale. Scales in mm.

REMARKS

This barnacle is white and tooth-like, and notable by the displacement of the umbos of both the rostrum and carina from the margins so that they slightly project in a recurved fashion. The plates are very finely striated and traversed by fine growth lines. The articulations between the movable tergum and movable scutum, and between the rostrum and carina, is very finely sinuous, with up to 12 small ribs interlocking.

The mandible is more solid than in other species. The rami of cirri I-VI are subequal. Mean numbers of segments per cirri in the larger specimen, 6.5 mm rcl, as follows, anterior ramus first:

I	II	III	IV	V	VI	ca
17,19	20,20	23,24	24,27	25,27	26,27	25

The caudal appendages are particularly long, 24 and 27 segments in the dissected specimen.

Family ARCHAEOBALANIDAE Newman & Ross, 1976

Acasta fenestrata Darwin, 1854

(Fig. 15 A-I)

MATERIAL. — MD32/La Réunion: CP176, 195 m (2 specimens). MUSORSTOM 2 (Philippines): Stn 33, 13°32.3' N, 121°07.5' E, 135 m (9).

RECORDS. — DARWIN 1854: 316, Philippines; HOEK 1883: 160, Philippines, 33 m; NILSSON-CANTELL 1938: 57, India, 46-51 m, Japan; HIRO 1939: 243, Japan. NEWMAN & ROSS (1976:53) for full references and distribution, Red Sea to Japan, 0 to 51 m. ROSELL (1989: 33), Philippines, 81-84 m.

REMARKS

Acasta contains over 60 described species. Most species associate with sponges, and there is a varying degree of reduction of the shell compartments, both in thinness (brittleness) and in association with wide gaps forming between the parietes below the completed growth of radii and alae of the rostral and lateral plates. This latter condition was noted by DARWIN (1854) to characterise the *A. fenestrata*. Whereas not all so-fenestrated acastids are *A. fenestrata* (e.g. *A. pectinipes* Pilsbry, 1912 — see FOSTER 1980), the present material does not differ from available descriptions of *A. fenestrata*; in particular it has a tergum with a wide spur set close to the basitergal angle, and the anterior ramus of cirrus IV is toothed.

The distribution of *A. fenestrata* is Indo-West Pacific, now with considerable extension of the known depth range (to 195 m) at Réunion Island.

Acasta demura nov. sp.

(Fig. 15 J-Q)

MATERIAL. — MD32/La Réunion: CP43, 77 m (3 specimens, in alcyonarian).

HOLOTYPE. — Dissected specimen of figure 15J, MNHN Ci 2141. Paratypes MNHN Ci 2142.

DESCRIPTION

Acasta with a squat, fragile shell, embedded in alcyonarian host. Carinolatus paries narrow, 1/12 width of that of the latus. Radii of carinolatus and latus wide. Compartments internally regularly ribbed along basal edge. Tergum with broad truncated spur set close to basiscutal angle, apex recurved, without crests for depressor muscles. Scutum triangular, with crenulated growth ridges and faint longitudinal striations; internally smooth except for faint pit for lateral depressor muscle.

Mandible with 3 main teeth and a molariform lower edge. Cirrus I with anterior ramus (9 segments) nearly twice as long as posterior ramus (6). Cirrus II with anterior ramus

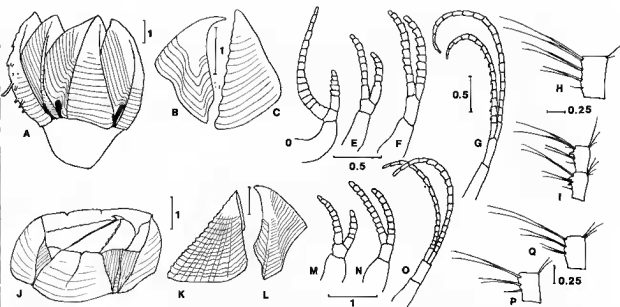


FIG. 15. — Archaeobalanidae. A-I, *Acaeta fenestrata*: A, shell and base, MD32, CP176, carina to left. B, C, tergum and scutum, outer views, Musorstom 2, Stn 33. D, cirrus I. E, cirrus II. F, cirrus III. G, cirrus IV. H, intermediate segment cirrus IV. I, intermediate segment cirrus VI. D-I, Musorstom 2, Stn 33. J-Q *Acaeta demura* nov. sp. J, shell and opercula in-situ in oblique view, carina to right, MD32, CP43. K, L, scutum and tergum, outer view. M, cirrus I. N, cirrus II. O, cirrus III. P, intermediate segment cirrus IV. Q, intermediate segment cirrus VI. K-Q of specimen J from MD32, CP43. Scales in mm.

(11 segments) slightly longer than posterior ramus (9). Cirri III-VI with subequal rami (17,19; 23,26; —; 24,23). Without recurved hooks on cirrus IV. Penis very long (3 times the length cirrus VI).

REMARKS

The species known to occur in alcyonarians are *A. echinata* Hiro (1937b) from 15-20 m, *A. alcyonicola* Utinomi (1953) both from Japan, and *A. sculpturata* Broch (1931) from Java, 49 m. *A. demura* more resembles *A. spinitergum* Broch (1931), which occurs in gorgonians, than any of the described alcyonarian-living ones, but differs from it by the segmentation of the cirri and the much narrower carinolatus.

BIOGEOGRAPHY

Summary data are presented in table 1, which provides the number of stations, number of individuals and depth data from these collections and from the literature, for each of the species. Full station data are given in the appendix.

The frequency of recovery of barnacles in the deep sea grabs and dredges is 22 % (39 of 181 stations) for the MD32/La Réunion cruise, yielding 408 specimens (28 species).

The Réunion Island (MD32) stations yielded 408 specimens: 28 species, 5 of which are new (*Oxynaspis acapitula*, *Verum constrictum*, *Verruca sinuosa*, *Metaverruca reunioni* and *Acasta demura*). *M. reunioni* is so far only known from Réunion Island. The 4 extra samples from Indonesia/Philippines yielded 6 species.

The material, contains a clear Indo-Malay to Indo-Pacific shallow water suite of species, of a tropical nature, such as species of *Octolasmis*, *Oxynaspis*, and *Acasta*, and specifically *Calantica pusilla*, *Rostratoverruca conchula* and *Brochiverruca dens*, all notably distinct from Atlantic cogenitors, and mostly associated with various coral-like or cnidarian host substrata.

By the discovery of 5 new species, and noting the level of new species description (5 out of 31, i. e. 16 %) within these collections, it is clear that there is still much to appreciate about barnacle taxa that live in the deep sea. It is necessary for sampling to be maintained, and the follow-up systematics practised. The present collection of barnacles from CENTOB are a significant contribution.

TABLE I. — Summary data on numbers of stations, individuals and depths for each of the species.

SPECIES	N° of stations	Indiv. sample numbers	Tot. n°.	DEPTH RANGE (m):	
				this paper	literature
<i>Heteralepas japonica</i>	4	1 39 14 1	55	120-490	48-2090
<i>Octolasmis orthogonia</i>	1	3	3	120	18-818
<i>Octolasmis niestraszi</i>	3	3 3 1	7	75-92	16-135
<i>Megalasma annandalei</i>	1	3	3	980	1406
<i>Oxynaspis alatae</i>	1	1	1	150	
<i>Oxynaspis indica</i>	1	3	3	75	50-1400
<i>Oxynaspis gracilis</i>	1	1	1	120	
<i>Oxynaspis acapitula</i> nov. sp.	1	2	2	120	
<i>Calantica pusilla</i>	2	1 1	2	70-110	35-100
<i>Calantica pollicipedoides</i>	1	1	1	135	24-190
<i>Trianguloscalpellum regium</i>	1	1	3	4030	845-5212
<i>Arcoscalpellum triangulare</i>	1	2	2	135	370-1029
<i>Arcoscalpellum truncatum</i>	2	2 11	13	2850-2970	2520-3060
<i>Amigdoscalpellum praeceps</i>	4	1 1 9 1	12	1660-2970	411
<i>Amigdoscalpellum mamillatum</i>	1	1	1	1850	512-4020
<i>Verum minutum</i>	2	3 2	5	1850-3520	802-2652
<i>Verum proclive</i>	2	1 1	2	710-2850	655
<i>Weltnerium poculum</i>	1	2	2	135	918
<i>Annandaleum laccadivicum</i>	1	3	3	1175	234-2130
<i>Planoscalpellum distinctum</i>	1	5	5	1850	1300-2745
<i>Verum constrictum</i> nov. sp.	2	1 1	2	1850	
<i>Verruca trisulcata</i>	3	3 2 1	6	980-1690	441-998
<i>Verruca sinuosa</i> nov. sp.	1	3	3	980	
<i>Verruca cookei</i>	1	2	2	0-10	

<i>Verruca quadrangularis</i>	6	36	3	1	21	1	1	63	980-2850	907-3460
<i>Metaverruca recta</i>	2	1	1					2	620-1230	160-2110
<i>Metaverruca reunioni</i> nov. sp.	8	4	1	1	136	24	4	2	173	780-3510
<i>Rostratoverruca conchula</i>	8	5	1	1	16	1	3	2	1	30
<i>Brochiverruca dens</i>	1	2						2	720	348-368
<i>Acasta fenestrata</i>	2	2	9					11	135-195	0?-51
<i>Acasta demura</i> nov. sp.	1	3						3	77	

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REFERENCES

- ANNANDALE, N., 1906. — Natural history notes from the R.I.M.S. ship "Investigator", ser. 3, n° 12: Preliminary report on the Indian stalked barnacles. *Ann. Mag. nat. Hist.*, ser. 7, 17: 389-400.
- 1910. — An account of the Indian Cirripedia Pedunculata. *Mem. Indian Mus.*, 2: 60-138.
- AURIVILLIUS, C. W. S., 1892. — Neue Cirripeden aus dem Atlantischen, Indischen und Stillen Ocean. *Ofvers. Vetensk Akad. Forh.*, 3: 123-134.
- 1894. — Studien über Cirripeden. *K. svenska Vetensk Akad. Handl.*, 26: 1-107.
- 1898. — Cirripèdes nouveaux provenant des Campagnes scientifiques de S.A.S. le Prince de Monaco. *Bull. Soc. zool. Fr.*, 23: 189-198.
- BARNARD, K. F., 1924. — Contributions to the crustacean fauna of South Africa. N° 7, Cirripedia. *Ann. S. Afr. Mus.*, 20: 1-103.
- BROCH, H., 1922. — Studies on Pacific Cirripedes. Papers from Dr Th. MORTENSEN's Pacific Expedition, 1914-1916. X. *Vidensk. Medd. fra dansk. naturh. Foren.*, 73: 215-358.
- 1931. — Indomalayan Cirripedia. Papers from Dr Th. MORTENSEN's Pacific Expedition 1914-16. *Vidensk. Medd. fra dansk naturh. Foren.*, 91: 1-142.
- 1953. Cirripedia Thoracica. Danish Ingolf Expedition, 3 (14): 1-17.
- BUCKERIDGE, J. S., 1983. — Fossil barnacles (Cirripedia: Thoracica) of New Zealand and Australia. *N. Z. Geol. Survey Paleontol. Bull.*, 50: 1-151.
- 1994. — Cirripedia Thoracica : Verrucomorpha of New Caledonia, Indonesia, Wallis and Futuna Islands. In : A. CROSNIER (ed.), Résultats des campagnes MUSORSTOM, Volume 12. *Mém. Mus. natn. Hist. nat.*, Paris, 161: 87-125.
- CALMAN, W. T., 1918. — On barnacles of the genus *Scalpellum* from deep sea telegraph cables. *Ann. Mag. nat. Hist.*, ser. 9, n° 1: 96-124.
- DARWIN, C. R., 1851. — A Monograph of the Subclass Cirripedia, The Lepadidae or Pedunculate Cirripedes. Ray Soc., London. 400 p.

- 1854. — A Monograph of the Subclass Cirripedia, with figures of all the species. The Balanidae, the Verrucidae, etc. Ray Soc., London. 684 p.
- FOSTER, B. A., 1978. — The marine fauna of New Zealand. Barnacles (Cirripedia: Thoracica). *Mem. N. Z. oceanogr. Inst.*, **69**, Wellington: 1-160.
- 1980. — Further records and classification of scalpellid barnacles (Cirripedia, Thoracica) from New Zealand. *N. Z. J. Zool.*, **7**: 523-531.
- 1981. — Cirripedes from ocean ridges north of New Zealand. *N. Z. J. Zool.*, **8**: 349-367.
- 1982. — Shallow water barnacles from Hong Kong. Proc. First Int. Mar. Biol. Workshop: The Marine Flora and Fauna of Hong Kong and Southern China (B. S. MORTON & C. K. TSENG, eds), vol. 1: 207-232.
- 1990. — A new species of *Euraphia* (Cirripedia: Chthamalidae) from Micronesia. *Crustaceana*, **58**: 309-313.
- GRUVEL, A., 1900a. — Sur quelques espèces nouvelles du genre *Scalpellum* provenant de la campagne du "Talisman". *Bull. Mus. Hist. nat.*, Paris, **6** (4) : 189-194.
- 1900b. — Sur les espèces nouvelles appartenant au genre *Verruca* provenant de la campagne du "Talisman". *Bull. Mus. Hist. nat.*, Paris, **6** (5) : 242-244.
- 1901. — Diagnoses de quelques espèces nouvelles de Cirrhipèdes. *Bull. Mus. Hist. nat.*, Paris, **7** (6) : 256-263.
- 1902. — Cirrhipèdes. In: Expéditions Scientifiques du "Travailleur" et du "Talisman" pendant les années 1880-1883, Masson et Cie, Paris. 178 p.
- 1905. — Monographie des Cirrhipèdes ou Thécostracés. Masson et Cie, Paris. 472 p.
- 1907. — Cirrhipèdes operculés de l'Indian Museum de Calcutta. *Mem. asiat. Soc. Beng.*, **2** : 1-10.
- 1912a. — Note préliminaire sur les Cirrhipèdes recueillis pendant les Campagnes scientifiques de S.A.S. le Prince de Monaco. *Bull. Inst. oceanogr. Monaco*, **241** : 1-7.
- 1912b. — Mission Gruvel sur la côte occidentale d'Afrique (1909-1910) et collection du Muséum d'Histoire naturelle. Les Cirrhipèdes. *Bull. Mus. Hist. nat.*, Paris, **18** (6): 344-350.
- 1920. — Cirrhipèdes provenant des Campagnes scientifiques de S.A.S. le Prince de Monaco (1885-1913). Résult. Camp. scient. Prince Albert I, **53** : 3-88.
- HENRY, D. P., 1957. — Some littoral barnacles from the Tuamotu, Marshall and Caroline Islands. *Proc. U. S. natl. Mus.*, **107**: 25-38.
- HIRO, F., 1931. — Notes on some new Cirripedia from Japan. *Mem. Coll. Sci. Kyoto Univ.*, ser. B, **7**: 143-158.
- 1933. — Report on the Cirripedia collected by the surveying ships of the Imperial Fisheries Experimental Station on the continental shelf bordering Japan. *Rec. oceanogr. Wks. Jap.*, **5**: 11-84.
- 1937a. — Studies on cirripedian fauna of Japan. II. Cirripeds found in the vicinity of the Seto Marine Biological Laboratory. *Mem. Coll. Sci. Kyoto Univ.*, ser. B, **12**: 385-478.
- 1937b. — A new barnacle *Acasta echinata* n. sp. imbedded in the stalk of an alcyonarian from southern Japan. *Zool. Mag. Tokyo*, **49**: 70-71.
- 1939. — Studies on the cirripedian fauna of Japan. III. Supplementary notes on the cirripeds found in the vicinity of Seto. *Mem. Coll. Sci. Kyoto Univ.*, ser. B, **15**: 237-244.
- HOEK, P. P. C., 1883. — Report on the Cirripedia collected by H.M.S. "Challenger" during the years 1873-76. *Rep. Sci. Results Voyage H.M.S. Challenger 1873-76*, Zool., **8**: 1-169.
- 1907a. — The Cirripedia of the Siboga Expedition. A. Cirripedia Pedunculata. *Siboga Exped., Monogr.*, **31a**: 1-127.
- 1907b. — Cirripedia. In: Resultats Voyage S.Y. Belgica 1897-1899. *Rapp. Sci. Zool. Anvers*: 3-9.
- 1913. — The Cirripedia of the Siboga Expedition. B. Cirripedia Sessilia. *Siboga Exped., Monogr.* **31b**: 129-275.

- NEWMAN, W. A., 1972. — An oxynaspid (Cirripedia, Thoracica) from the Eastern Pacific. *Crustaceana*, **23** (3): 202-208.
- 1979. — A new scalpellid (Cirripedia); a Mesozoic relic living near an abyssal hydrothermal spring. *Trans. S. Diego Soc. nat. Hist.*, **19**: 153-167.
- 1987. — Evolution of cirripedes and their major groups. In: *Barnacle Biology*: (A.J. Southward, ed.) 3-42. Balkema, Rotterdam. 443 p.
- NEWMAN, W. A., & R. R. HESSLER, 1989. — A new abyssal hydrothermal verrucomorphan (Cirripedia; Sessilia): The most primitive living sessile barnacle. *Trans. S. Diego Soc. nat. Hist.*, **21**: 259-273.
- NEWMAN, W. A., & A. ROSS, 1976. — Revision of the balanomorph barnacles: Including a catalog of the species. *Mem. S. Diego Soc. nat. Hist.*, **9**: 1-108.
- 1971. — Antarctic Cirripedia. Antarctic Research Series, vol. 14. American Geophysical Union, Washington. 257 p.
- NILSSON-CANTELL, C. A., 1921. — Cirripeden-Studien. Zur Kenntniss der Biologie, Anatomie und Systematik dieser Gruppe. *Zool. Bijdr.*, **7**: 75-395.
- 1925. — Neue und wenig bekannte Cirripeden aus dem Museum zu Stockholm und zu Uppsala. *Ark. Zool.*, **18A**: 1-46.
- 1927. — Some barnacles in the British Museum (Nat. Hist.). *Proc. zool. Soc. Lond.*, **3**: 743-790.
- 1928. — Studies on cirripeds in the British Museum (Nat. Hist.). *Ann. Mag. nat. Hist.*, ser. 10, **2**: 1-39.
- 1929. — Cirripeden des genus *Verruca* der Deutsche Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899. *Zool. Jb.*, **58**: 459-480.
- 1934a. — Indo-Malayan cirripeds in the Raffles Museum, Singapore. *Bull. Raffles Mus.*, **9**: 42-73.
- 1934b. — Cirripeds from the Malay Archipelago in the Zoological Museum of Amsterdam. *Zool. Meded.*, Leiden, **17**: 31-63.
- 1938. Cirripeds from Indian Ocean in the collection of the Indian Museum, Calcutta. *Mem. Indian Mus.*, **13**: 1-81.
- PILSBRY, H. A., 1907a. — The barnacles (Cirripedia) contained in the collections of the U.S. National Museum. *Bull. U.S. natl Mus.*, **60**: 1-122.
- 1907b. — Hawaiian Cirripedia. *Bull. Bur. Fish.*, Wash., **26**: 179-190.
- 1911. — Barnacles of Japan and Bering Sea. *Bull. Bur. Fish.*, Wash., **29**: 59-84.
- 1912. — Diagnoses of new barnacles from the Philippine Archipelago and China Sea. *Proc. U.S. natl Mus.*, **42**: 291-294.
- 1916. — The sessile barnacles (Cirripedia) contained in the collections of the U.S. National Museum; including a monograph of the American species. *Bull. U.S. natl Mus.*, **93**: 1-366.
- 1927. — Littoral barnacles of the Hawaiian Islands and Japan. *Proc. Acad. nat. Sci., Philad.*, **79**: 305-317.
- 1953. — Notes on floridan barnacles (Cirripedia). *Proc. Acad. nat. Sci., Philad.*, **105**: 13-28.
- ROSSELL, N. C. 1981. — Résultats des Campagnes MUSORSTOM 1. Philippines (18-28 March 1976), Vol. 1, 12, Crustacea: Cirripedia. *Mém. ORSTOM.*, (91) : 277-307.
- 1989. — Thoracic cirripeds from the MUSORSTOM 2 Expedition. In: Résultats des Campagnes MUSORSTOM (J. FOREST, éd.), vol. 5. *Mem. Mus. natl. Hist. nat.*, Paris, (A), 144 : 9-35.
- SOUTHWARD, A. J., & E. C. SOUTHWARD, 1958. — On the occurrence and behaviour of two little-known barnacles, *Hexelasma hirsutum* and *Verruca recta*, from the continental slope. *J. mar. biol. Ass. U.K.*, **37**: 633-647.
- STEBBING, T. R. R., 1900. — On Crustacea brought by Dr WILLEY from the South Seas. Results based on material from New Britain, Loyalty Islands and elsewhere, collected during the years 1895-1896 and 1897. Part 5: 605-690.

- STUBBINGS, H. G., 1936. — Cirripedia. John MURRAY Exped. 1933-34, *Scient. Rep.*, 4: 1-70.
- 1963. — Cirripedia from South Vietnam. *Vidensk. Meddr dansk. naturh. Foren.*, 125: 327-335.
- THOMSON, W., 1873. — Notes from the "Challenger". *Nature*, Aug. 28: 347-349.
- TOTTON, A. K., 1923. — Coelenterata, Part 3. Antipatharia and their cirripede commensals. *Brit. Antarct. Terra Nova Exped. 1910*, *Zool.* 5: 97-120.
- 1940. — New species of the cirripede genus *Oxynaspis* commensal with Antipatharia. *Ann. Mag. nat. Hist.*, 6: 465-486.
- UTINOMI, H., 1953. — On two interesting species of epizoic barnacles *Acasta* from Japan. *Mem. Coll. Sci., Kyoto Univ.*, ser. B, 20: 139-144.
- 1958. — A new stalked cirripede (*Pistiscalpellum wthersti* n. gen et n. sp.) from Sagami Bay and a discussion on its phylogeny. *Jap. J. Zool.*, 12: 113-122.
- 1970. — New and rare commensal pedunculate cirripeds from Amakusa Islands, western Kyusyu, Japan. *Publ. Seto mar. biol. Lab.*, 18: 157-167.
- WELTNER, W., 1922. — Cirripedia der Deutschen Tiefsee-Expedition. *Wissensch. Ergebn. Deutsch. Tiefsee-Exped., Valdivia, 1898-1899*. 23: 59-112.
- ZEVINA, G. B., 1975. — Cirripedia Thoracica of the American Mediterranean. In: Complex investigations of the Caribbean, the Gulf of Mexico and adjacent waters. *Publ. of Shirshov Inst. Oceanology*, 100: 233-258 (in Russian).
- 1978a. — A new classification of the family Scalpellidae Pilsbry (Cirripedia, Thoracica). Part 1. Subfamilies Lithotryinae, Calantincinae, Pollicipinae, Scalpellinae, Brochiinae and Scalpellopsinae. *Zool. Zh.*, 57 (7): 998-1007 (in Russian).
- 1978b. — A new classification of the subfamily Scalpellidae Pilsbry (Cirripedia, Thoracica). Part 2. Subfamilies Arcoscalpellinae and Meroscalpellinae. *Zool. Zh.*, 57 (9): 1343-1352 (in Russian).
- 1980. — A new classification of Lepadomorpha (Cirripedia). *Zool. Zh.*, 54 (5): 689-698 (in Russian).
- 1981. — Barnacles of the suborder Lepadomorpha (Cirripedia, Thoracica) of the World Ocean. Part 1. Family Scalpellidae. Guides to the Fauna of USSR, 127. Zoological Institute of the Academy of Sciences of the U.S.S.R., Leningrad. 406 p. (in Russian).
- 1982. — Barnacles of the suborder Lepadomorpha (Cirripedia, Thoracica) of the World Ocean. Part 2. Guides to the Fauna of USSR, 133. Zoological Institute of the Academy of Sciences of the U.S.S.R., Leningrad. 223 p. (in Russian).
- 1983. — The Cirripedia from peaks of the Nasca Ridge mountains (Pacific Ocean). *Zool. Zh.*, 62 (11): 1635-1642 (in Russian).
- 1987. — Abyssal Cirripedia Verrucomorpha (Thoracica) of the Atlantic and Indian Oceans. *Zool. Zh.*, 66 (9): 1304-1313 (in Russian).

APPENDIX.

Cruise and station data, and barnacles and numbers of barnacles collected at each station. MD32/La Réunion: This material was collected during the MD32 cruise, sampling to 4 000 m around the Réunion Island, organised by the Terres Australes et Antarctiques Françaises (TAAF, Paris); chief, Alain GUILLE (Muséum). Dates: 11.VIII.82-10.IX.82.

Stn	m	°S	°E	species	#
DC10	930-980	21.133	55.520	<i>Verruca trisulcata</i>	3
				<i>Metaverruca reunioni</i>	4
DC14	2085-175	21.155	56.068	<i>Amigdoscalpellum praeceps</i>	1
CP21	4030	21.281	56.324	<i>Trianguloscalpellum regium</i>	3
FA39	70	21.207	55.280	<i>Calantica pusilla</i>	1
FA40	150	21.211	55.267	<i>Heteralepas japonica</i>	1
				<i>Oxynaspis alatae</i>	1
				<i>Rostratoverruca conchula</i>	5
CP43	73-77	21.207	55.269	<i>Oxynaspis indica</i>	3
				<i>Acasta demura</i>	3
DR47	205-215	21.229	55.365	<i>Rostratoverruca conchula</i>	1
PL53	0-10	20.555	55.176	<i>Verruca cookei</i>	2
CP57	210-227	21.045	55.110	<i>Heteralepas japonica</i>	39
CP60	460-490	21.033	55.095	<i>Heteralepas japonica</i>	14
DR62	630-710	21.087	55.118	<i>Verum proclive</i>	1
DC64	1150-1180	21.121	55.040	<i>Verruca quadrangularis</i>	36
DS78	1175-1200	21.132	55.038	<i>Annandaleum laccadivicum</i>	3
				<i>Verruca quadrangularis</i>	3
DR90	65	19.449	54.086	<i>Oxynaspis gracilis</i>	1
CP103	2950-2970	20.416	54.568	<i>Arcoscalpellum truncatum</i>	2
				<i>Amigdoscalpellum praeceps</i>	1
CP105	1740-1850	20.474	55.044	<i>Amigdoscalpellum mamillatum</i>	1
				<i>Verum minutum</i>	3
				<i>Planoscalpellum distinctum</i>	5
				<i>Verruca quadrangularis</i>	1
DR108	1220-1230	20.520	55.050	<i>Verruca quadrangularis</i>	21
DS109	1050-1240	20.523	55.063	<i>Metaverruca recta</i>	1
				<i>Metaverruca reunioni</i>	1
DC112	740-780	20.533	55.085	<i>Metaverruca reunioni</i>	1
FA118	675-720	20.522	55.059	<i>Brochiverruca dens</i>	2
CP127	27	20.520	55.371	<i>Octolasmis nierstraszi</i>	3
DC128	280-340	20.511	55.363	<i>Rostratoverruca conchula</i>	1
CP130	300-380	20.512	55.368	<i>Rostratoverruca conchula</i>	16
DS131	345-375	20.512	55.366	<i>Rostratoverruca conchula</i>	1
DC136	915-922	20.463	55.359	<i>Metaverruca reunioni</i>	136
FA137	940-980	20.458	55.356	<i>Megalasma annandalei</i>	3
				<i>Verruca trisulcata</i>	2
				<i>Verruca sinuosa</i>	3
				<i>Verruca quadrangularis</i>	1
				<i>Metaverruca reunioni</i>	24

DC138	1500-1590	20.412	55.361	<i>Metaverruca reunioni</i>	4
DS139	1575-1600	20.465	55.383	<i>Metaverruca reunioni</i>	2
CP140	1612-1690	20.412	55.382	<i>Verruca trisulcata</i>	1
CP144	605-620	20.503	55.354	<i>Metaverruca recta</i>	1
CP146	2830-2850	20.327	55.409	<i>Arcoscalpellum truncatum</i>	11
				<i>Amigdoscalpellum praeceps</i>	9
				<i>Verum proclive</i>	1
				<i>Verum constrictum</i>	1
				<i>Verruca quadrangularis</i>	1
DS149	3500-3510	20.260	55.404	<i>Metaverruca reunioni</i>	1
CP150	3450-3520	20.274	55.413	<i>Verum minutum</i>	2
				<i>Verum constrictum</i>	1
CP155	40-75	21.003	55.432	<i>Octolasmis nierstraszi</i>	3
FA158	180-525	20.590	55.433	<i>Rostratoverruca conchula</i>	3
DC163	1600-1660	20.592	55.470	<i>Amigdoscalpellum praeceps</i>	1
CP172	105-120	20.518	55.377	<i>Heteralepas japonica</i>	1
				<i>Octolasmis orthogonia</i>	3
				<i>Oxynaspis acapitula</i>	2
				<i>Calantica pusilla</i>	1
				<i>Rostratoverruca conchula</i>	2
DS173	270	20.515	55.368	<i>Rostratoverruca conchula</i>	1
CP176	165-195	21.017	55.106	<i>Acasta fenestrata</i>	2